

Chapter 1: The Anaesthetic of Familiarity

To live at all is miracle enough.

- Mervyn Peake

We are going to die, and that makes us the lucky ones. Most people are never going to die because they are never going to be born. The potential people who could have been here in my place but who will in fact never see the light of day outnumber the sand grains of Sahara. Certainly those unborn ghosts include greater poets than Keats, scientists greater than Newton. We know this because the set of possible people allowed by our DNA so massively outnumbers the set of actual people. In the teeth of these stupefying odds it is you and I, in our ordinariness, that are here.

Moralists and theologians place great weight upon the moment of conception, seeing it as the instant at which the soul comes into existence. If, like me, you are unmoved by such talk, you still must regard a particular instant, nine months before your birth, as the most decisive event in your personal fortunes. It is the moment at which your consciousness suddenly became trillions of times more foreseeable than it was a split second before. To be sure, the embryonic you that came into existence still had plenty of hurdles to leap. Most conceptuses end in early abortion before their mother even knows they are there, and we were all lucky not to do so. Also, there is more to personal identity than genes, as identical twins (who separate after the moment of fertilization) show us. Nevertheless, the instant at which a particular spermatozoon penetrated a particular egg was, in your private hindsight, a moment of dizzying singularity. It was then that the odds against your becoming a person dropped from astronomical to single figures.

The lottery starts before we are conceived. Your parents had to meet, and the conception of each was as improbable as your own. And so on back, through your four grandparents and eight great grandparents, back to where it doesn't bear thinking about.

Desmond Morris opens his autobiography, *Animal Days*, in characteristically arresting vein:

Napoleon started it all. If it weren't for him, I might not be sitting here now writing these words . . . for it was one of his cannonballs, fired in the Peninsular War, that shot off the arm of my great-great-grandfather, James Morris, and altered the whole course of my family history.

Morris tells how his ancestor's enforced change of career had various knock-on effects culminating in his own interest in natural history. But he really needn't have bothered. There's no 'might' about it. *Off course* he owes his very existence to Napoleon. So do I and so do you. Napoleon didn't have to shoot off James Morris's arm in order to seal young Desmond's fate, and yours and mine too. Not just Napoleon but the humblest mediaeval peasant had only to sneeze in order to affect something which changed something else which, after a long chain reaction, led to the consequence that one of your would-be ancestors failed to be your ancestor and became somebody else's instead. I'm not talking about 'chaos theory' or the equally trendy 'complexity theory' but just the ordinary statistics of causation. The thread of historical events by which our existence hangs is wincingly tenuous.

When compared with the stretch of time unknown to us, O king, the present life of men on earth is like the flight of a single sparrow through the hall where, in winter, you sit with your captains and ministers. Entering at one door and leaving by another, while it is inside it is untouched by the wintry storm; but this brief interval of calm is over in a moment, and it returns to the winter whence it came, vanishing from your sight. Man's life is similar; and of what follows it, or what went before, we are utterly ignorant.

- *The Venerable Bede (673-735 AD)*

This is another respect in which we are lucky. The universe is older than 100 million centuries. Within a comparable time the sun will swell to a red giant and engulf the earth. Every century of hundreds of millions has been in its time, or will be when its time comes, 'the present century.' Interestingly, some physicists don't like the idea of a 'moving present', regarding it as a subjective phenomenon for which they find no house-room in their equations. But it is a

subjective argument I am making. How it feels to me, and I guess to you as well, is that the present moves from the past to the future, like a tiny spotlight, inching its way along a gigantic ruler of time. Everything behind the spotlight is in darkness, the darkness of the dead past. Everything ahead of the spotlight is in the darkness of the unknown future. The odds of your century's being the one in the spotlight are the same as the odds that a penny, tossed down at random, will land on a particular ant crawling somewhere along the road from New York to San Francisco. In other words it is overwhelmingly probable that you are dead.

In spite of these odds you will notice that you are, as a matter of fact, alive. People whom the spotlight has already passed over, and people whom the spotlight has not reached, are in no position to read a book. I am equally lucky to be in a position to write one, although I may not be when you read these words. Indeed, I rather hope that I shall be dead when you do. Don't misunderstand me. I love life and hope to go on for a long time yet, but any author wants his works to reach the largest possible readership. Since the total future population is likely to outnumber my contemporaries by a large margin, I cannot but aspire to be dead when you see these words. Facetiously seen, it turns out to be no more than a hope that my book will not soon go out of print. But what I see as I write is that I am lucky to be alive and so are you.

We live on a planet that is all but perfect for our kind of life: not too warm and not too cold, basking in kindly sunshine, softly watered; a gently spinning, green and gold harvest-festival of a planet. Yes, and alas, there are deserts and slums; there is starvation and racking misery to be found. But take a look at the competition. Compared with most planets this is paradise, and parts of Earth are still paradise by any standards. What are the odds that a planet picked at random will have these complaisant properties? Even the most optimistic calculation will put it at less than one in a million.

Imagine a spaceship full of sleeping explorers, deep-frozen would-be colonists of some distant world. Perhaps the ship is on a forlorn mission to save the species before an unstoppable comet, like the one that killed the dinosaurs, hits the home planet. The voyagers go into the deep-freeze soberly reckoning the odds against their spaceship's ever chancing upon a planet friendly to life. If one in a million planets is suitable at best, and it takes centuries to travel from each star to the next, the spaceship is pathetically unlikely to find a tolerable, let alone safe, haven for its sleeping cargo.

But imagine that the ship's robot pilot turns out to be unthinkably lucky. After millions of years the ship does find a planet capable of sustaining life: a planet of equable temperature, bathed in warm starshine, refreshed by oxygen and water. The passengers, Rip van Winkels, wake stumbling into the light. After a million years of sleep, here is a whole new fertile globe, a lush planet of warm pastures, sparkling streams and waterfalls, a world bountiful with creatures, darting through alien green felicity. Our travellers walk entranced, stupefied, unable to believe their unaccustomed senses or their luck.

As I said, the story asks for too much luck; it would never happen. And yet, isn't it what *has* happened to each one of us? We *have* woken after hundreds of millions of years asleep, defying astronomical odds. Admittedly we didn't arrive by spaceship, we arrived by being born, and we didn't burst conscious into the world but accumulated awareness gradually through babyhood. The fact that we gradually apprehend our world, rather than suddenly discovering it, should not subtract from its wonder.

Of course I am playing tricks with the idea of luck, putting the cart before the horse. It is no accident that our kind of life finds itself on a planet whose temperature, rainfall and everything else are exactly right. If the planet were suitable for another kind of life, it is that other kind of life that would have evolved here. But we as individuals are still hugely blessed. Privileged, and not just privileged to enjoy our planet. More, we are granted the opportunity to understand why

our eyes are open, and why they see what they do, in the short time before they close forever.

Here, it seems to me, lies the best answer to those petty-minded scrooges who are always asking what is the *use* of science. In one of those mythic remarks of uncertain authorship, Michael Faraday is alleged to have been asked what was the use of science. "Sir," Faraday replied, "Of what use is a new-born child?" The obvious thing for Faraday (or Benjamin Franklin, or whoever it was) to have meant was that a baby might be no use for anything at present, but it had great potential for the future. I now like to think that he meant something else, too. What is the use of bringing a baby into the world if the only thing it does with its life is just work to go on living? If everything is judged by how 'useful' it is – useful for staying alive, that is – we are left wondering at a futile circularity.

There must be some added value. At least a part of life should be devoted to *living* that life, not just working to stop it ending. This is how we rightly justify spending taxpayers' money on the arts. It is one of the justifications properly offered for conserving rare species and beautiful buildings. It is how we answer those barbarians who think that wild elephants and historic houses should be preserved only if they 'pay their way'. And science is the same. Of course science pays its way; of course it is useful, but that is not *all* it is.

After sleeping through a hundred million centuries we have finally opened our eyes on a sumptuous planet, sparkling with colour, bountiful with life. Within decades we must close our eyes again. Isn't it a noble, an enlightened way of spending our brief time in the sun, to work at understanding the universe and how we have come to wake up in it? This is how I answer when I am asked – as I surprisingly often am – why I bother to get up in the mornings. To put it the other way round, isn't it sad to go to your grave without ever wondering why you were born? Who, with such a thought, would not spring from bed, eager to resume discovering the world and rejoicing to be a part of it?

The poet Kathleen Raine, who read Natural Sciences at Cambridge specialising in Biology, found related solace as a young woman unhappy in love and desperate for relief from heartbreak:-

Then the sky spoke to me in language clear,
familiar as the heart, than love more near.
The sky said to my soul, 'You have what you desire!

'Know now that you are born along with these
clouds, winds, and stars, and ever-moving seas
and forest dwellers. This your nature is.

'Lift up your heart again without fear,
sleep in the tomb, or breathe the living air,
this world you with the flower and with the tiger share.'

There is an anaesthetic of familiarity, a sedative of ordinariness which dulls the senses and hides the wonder of existence. For those of us not gifted in poetry, it is at least worthwhile from time to time making an effort to shake off the anaesthetic. What is the best way of countering the sluggish habituation brought about by our gradual crawl from babyhood? We can't actually fly to another planet. But we can recapture that sense of having just tumbled out to life on a new world, by looking at our own world in unfamiliar ways. It's tempting to use an easy example like a rose or a butterfly, but let's go straight for the alien deep end. I remember attending a lecture, years ago, by a biologist working on octopuses, and their relatives the squids and cuttlefish. He began by explaining his fascination with these animals. "You see," he said, "they are the Martians." Have you ever watched a squid change colour?

Television images are sometimes displayed on giant LED (Light Emitting Diode) hoardings. Instead of a fluorescent screen with an electron beam scanning side-to-side over it, the LED screen is a large array of tiny glowing lights, independently controllable. The lights are individually brightened or dimmed so that, from a distance, the whole matrix shimmers with moving pictures. The skin of a squid behaves like an LED screen. Instead of lights the skin is packed with thousands of tiny bags filled with ink. Each of these ink bags has

miniature private muscles to squeeze it. With a puppet string leading to each one of these separate muscles, the squid's nervous system can control the shape, and hence the visibility, of each ink sac.

In theory, if you wiretapped the nerves leading to the separate ink pixels and stimulated them electrically via a computer, you could play out Charlie Chaplin movies on the squid's skin. The squid doesn't do that, but its brain does control the wires with precision and speed, and the skinflicks that it shows are spectacular. Waves of colour chase across the surface like clouds in a speeded-up film; ripples and eddies race over the living screen. The animal signals its changing emotions in quick time: dark brown one second, blanching ghostly white the next, rapidly modulating interwoven patterns of stipples and stripes. When it comes to changing colour, chameleons are amateurs at the game.

The American neurobiologist William Calvin is one of those thinking hard today about what thinking itself really is. He emphasises, as others have done before, the idea that thoughts do not reside in particular places in the brain but are shifting patterns of activity over its surface, units recruiting neighbouring units into populations becoming the same thought, competing in Darwinian fashion with rival populations thinking alternative thoughts. We don't see these shifting patterns, but presumably we would if neurones lit up when active. The cortex of the brain, I realise, might look rather like a squid's body surface. Does a squid think with its skin? When a squid suddenly changes its colour pattern we suppose it to be a manifestation of mood change, for signalling to another squid. A shift in colour announces that the squid has switched from an aggressive mood, say, to a fearful one. It is natural to presume that the change in mood took place in the brain, and caused the change in colour as a visible manifestation of internal thoughts, rendered external for purposes of communication. The fancy I am adding is that the squid's thoughts themselves may reside nowhere but in the skin. If squids think with their skins they are even more 'Martian'

than my colleague realised. Even if that is too far-fetched a speculation (it is), the spectacle of their rippling colour changes is quite alien enough to jolt us out of our anaesthetic of familiarity.

Squids are not the only 'Martians' on our own doorstep. Think of the grotesque faces of deep sea fish, think of dust-mites, even more fearsome if they were not so tiny; think of basking sharks, just fearsome. Think, indeed, of chameleons with their catapult-launched tongues, swivelling eye turrets and cold, slow gait. Or we can capture the 'strange other world' feeling just as effectively by looking inside ourselves, at the cells that make up our own bodies. A cell is not just a bag of juice. It is packed with solid structures, mazes of intricately folded membranes. The total area of membrane inside a typical cell is 0.1 sq. mm. This may not sound much, but we forget how small a cell is and how many there are. There are about 100 million million in a human body. So the total area of membranous structure inside one human body works out at more than 200 acres. That's a respectable farm.

What are all these membranes doing? They seem to stuff the cell as wadding, but that isn't all they do. Much of the folded acreage is given over to chemical production lines, with moving conveyor-belts, hundreds of stages in cascade, each leading to the next in precisely crafted sequences, the whole driven by fast turning chemical cogwheels. The Krebs Cycle, the nine-toothed cogwheel that is largely responsible for making energy available to us, turns over at up to a hundred revolutions per second, duplicated thousands of times in every cell. Chemical cogwheel of particular marque are housed inside mitochondria, tiny bodies that reproduce independently inside our cells like bacteria. As we shall see, it is now widely accepted that the mitochondria, along with other vitally necessary structures within cells, not only resemble bacteria, they are directly descended from ancestral bacteria who, a billion years ago, gave up their freedom. Each one of us is a city of cells, and

each cell a town of bacteria. You are a gigantic megalopolis of bacteria. Doesn't that lift the anaesthetic's pall?

As a microscope helps our minds to burrow through alien galleries of cell membranes, and as a telescope lifts us to far galaxies, another way of coming out of the anaesthetic is to return, in imagination, through geological time. It is the inhuman age of fossils that knocks us back on our heels. We pick up a trilobite and the books tell us it is 500 million years old. But we ignominiously fail to comprehend such an age, and there is a yearning pleasure in the attempt. Our brains evolved to grasp the time-scales of our own lifetimes. Seconds, minutes, hours, days and years are easy for us. We can cope with centuries. When we come to millennia – thousands of years – our spines begin to tingle. Epic myths of Homer; deeds of the Greek gods Zeus, Apollo and Artemis; of the Jewish heroes Abraham, Moses and David and their terrifying god Yahweh; of the ancient Egyptians and the Sun God Ra: these inspire poets and give us that *frisson* of immense age. We seem to be peering back through eerie mists into the echoing strangeness of antiquity. Yet, on the timescale of our trilobite, those vaunted antiquities are scarcely yesterday.

Many dramatisations have been offered, and I shall essay another. Let us write the history of one year on a single sheet of paper. That doesn't leave much room for detail. It is roughly equivalent to the lightning 'Roundup of the Year' that newspapers trot out on December 31st. Each month gets a few sentences. Now on another sheet of paper write the history of the previous year. Carry on back through the years, sketching, at a rate of a year per sheet, the outline of what happened in each year. Bind the pages into a book and number them. Gibbon's *Decline and Fall of the Roman Empire* spans some 13 centuries in six volumes of about 500 pages each, so it is covering the ground at approximately the rate we are talking about.

"Another damned, thick, square book. Always scribble, scribble, scribble! Eh! Mr Gibbon?"

- William Henry, *First Duke of Gloucester*

That splendid volume *The Oxford Dictionary of Quotations*, from which I have just copied this remark, is itself a damned thick, square, doorstep of a book, and about the right size to take us back to the time of Queen Elizabeth the First. We have an approximate yardstick of time: 10 cm of book thickness to record the history of one millennium. Having established our yardstick, let's work back to the alien world of geological deep time. We place the book of the most recent past flat on the ground, then stack books of earlier centuries on top of it. We now stand beside the pile of books as a living yardstick. If we want to read about Jesus, say, we must select a volume 20 cm from the ground or just above the ankle.

A famous nineteenth-century archaeologist dug up a bronze age warrior with a beautifully preserved face mask and exulted: "I have gazed upon the face of Agamemnon." He was being poetically awed at his penetration of fabled antiquity. To find Agamemnon in our pile of books, you'd have to stoop about to a level half way up your shins. Somewhere in the vicinity you'd find Petra ("A rose-red city, half as old as time"), the Hanging Gardens of Babylon - enigmatic wonder of the ancient world - Ozymandias, King of Kings ("Look on my works, ye mighty, and despair"). Ur of the Chaldees, and Uruk the city of the legendary hero Gilgamesh had their day a little earlier and you'd find tales of their foundation a little higher up your legs. Around here is the oldest date of all, according to the seventeenth century bishop James Ussher who calculated 4004 BC as the date of the creation of Adam and Eve.

The taming of fire was climacteric in our history; from it stems most of technology. How high in our stack of books is the page on which this epic discovery is recorded? The answer is quite a surprise when you recall that you could comfortably sit down on the pile of books encompassing the whole of recorded history. Archeological traces suggest that fire was discovered (as well as boats, incidentally) by our ancestor *Homo erectus*, though whether they made fire, or just carried it about and used it we don't know. They had fire by half a

million years ago, so to consult the volume in our analogy recording the discovery you'd have to climb a ladder to a level somewhat higher than the Statue of Liberty. A dizzy height, especially given that Prometheus, the legendary bringer of fire, gets his first mention a little below your knee in our pile of books. To read about Lucy and our australopithecine ancestors in Africa, you'd need to climb higher than any building in Chicago. The biography of the common ancestor we share with chimpanzees would be a sentence in a book stacked twice as high again.

But we've only just begun our journey back to the trilobite. How high would the stack of books have to be, in order to accommodate the page where the life and death of this trilobite, in its shallow Cambrian sea, is perfunctorily celebrated? The answer is about 56 kilometres, or 35 miles. We aren't used to dealing with heights like this. The summit of Mount Everest is less than 9 km above sea level. We can get some idea of the age of the trilobite if we topple the stack through ninety degrees. Picture a bookshelf three times the length of Manhattan island, packed with volumes the size of Gibbon's *Decline and Fall*. To read your way back to the trilobite, with only a page allotted to each year, would be more laborious than spelling through all 14 million volumes in the Library of Congress. But even the trilobite is young compared with the age of life itself. The first living creatures, the shared ancestors of the trilobite, of bacteria and of ourselves, have their ancient chemical lives recorded in Volume 1 of our saga. Volume 1 is the far end of the marathon bookshelf. The entire bookshelf would stretch from London to the Scottish borders. Or right across Greece from the Adriatic to the Aegean.

Perhaps these distances are still unreal. The art in thinking of analogies for large numbers is not to go off the scale of what people can comprehend. If we do that, we are no better off with an analogy than with the real thing. Reading your way through a work of history, whose shelved volumes stretch from Rome to Venice, is an

incomprehensible task, just about as incomprehensible as the bald figure, 4000 million years.

Here is another analogy, one that has been used before. Fling your arms wide in an expansive gesture to span all of evolution from its origin at your left fingertip to today at your right fingertip. All the way across your midline to well past your right shoulder, life consists of nothing but bacteria. Many-celled, invertebrate life flowers somewhere around your right elbow. The dinosaurs originate in the middle of your right palm, and go extinct around your last finger joint. The whole story of *Homo sapiens* and our predecessor *Homo erectus* is contained in the thickness of one nail-clipping. As for recorded history; as for the Sumerians, the Babylonians, the Jewish patriarchs, the legions of Rome, the Christian Fathers, the dynasties of Pharaohs, the Laws of the Medes and Persians which never change; as for Troy and the Greeks, Helen and Achilles and Agamemnon dead; as for Napoleon and Hitler, the Beatles and the Spice Girls, they and everyone that knew them are blown away in the dust from one light stroke of a nail-file.

The poor are fast forgotten,
They outnumber the living, but where are all their bones?
For every man alive there are a million dead,
Has their dust gone into earth that it is never seen?
There should be no air to breathe, with it so thick,
No space for wind to blow, nor rain to fall;
Earth should be a cloud of dust, a soil of bones,
With no room even, for our skeletons;

- From *Agamemnon's Tomb* by Sacheverell Sitwell

Not that it matters, Sitwell's third line is inaccurate. It has been estimated that the people alive today make up a substantial proportion of the humans that have ever lived. But this just reflects the power of exponential growth. If we count generations instead of counting bodies, and especially if we go back beyond humankind to life's beginning, Sacheverell Sitwell's sentiment has a new force. Let us suppose that each individual in our direct female ancestry, from the first flowering of many-celled life a little over half a billion years

ago, lay down and died on the grave of her mother, eventually to be fossilized. As in the successive layers of the buried city of Troy, there would be much compression and shaking down, so let us assume that each fossil in the series was flattened to the thickness of a 1 cm pancake. What depth of rock should we need, if we are to accommodate our continuous fossil record? The answer is that the rock would have to be about 1000 km or 600 miles thick. This is about ten times the thickness of the earth's crust.

The Grand Canyon, whose rocks, from deepest to shallowest, span most of the period we are now talking about, is only around one mile deep. If the strata of the Grand Canyon were stuffed with fossils and no intervening rock, there would be room within its depth to accommodate only about one 600th of the generations that have successively died. This calculation helps us to keep in proportion fundamentalist demands for a 'continuous' series of gradually changing fossils before they will accept the fact of evolution. The rocks of earth simply don't have room for such a luxury – not by many orders of magnitude. Whichever way you look at it, only an extremely small proportion of creatures has the good fortune to be fossilised. As I've said before, I should consider it an honour.

The number of the dead long exceedeth all that shall live. The night of time far surpasseth the day, and who knows when was the Aequinox? Every houre addes unto that current Arithmetique, which scarce stands one moment. . . Who knows whether the best of men be known, or whether there be not more remarkable persons forgot than any that stand remembred in the known account of time?

Sir Thomas Browne, Urne Buriall